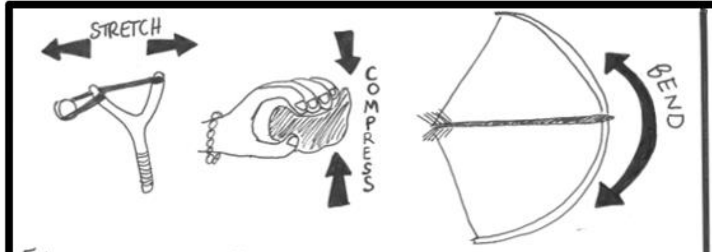
# P2.3 Forces in Action
OCR Gateway GCSE Physics

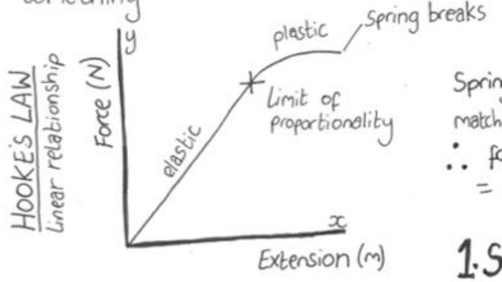
## 1. Springs




**Extension** – how far you can stretch something

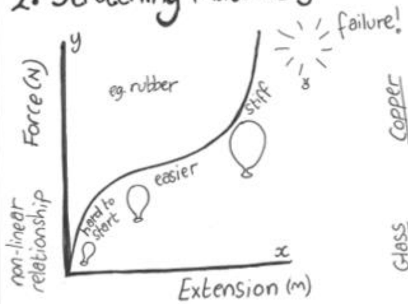
**Plastic** – doesn't bounce back

**Elastic** – bounces back

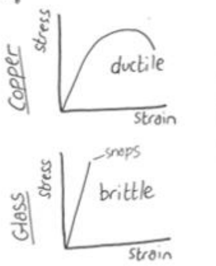



Spring constant (N/m) matches gradient = y/x
∴ force/extension = N/m

## 2. Stretching materials




other non-linear stress-strain graphs




Energy transferred in stretching = 0.5 × spring constant × extension²

J = 0.5 × N/m × m²

Deform = stores energy — crash, absorb energy

Elastic = transfers energy — bumper, bounce back

## 3. Gravity

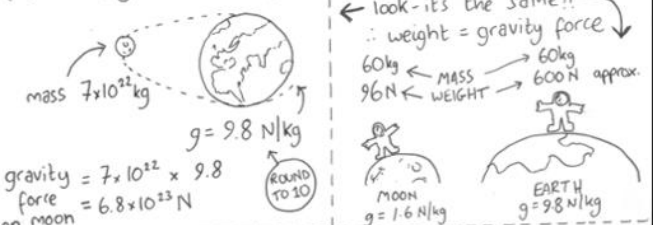
gravity force = mass (of affected object) × gravitational field strength

(N) = (kg) × (N/kg)

weight = mass × gravitational field strength

(N) = (kg) × (N/kg)

← look – it's the same!! ∴ weight = gravity force




∴ gravity force on moon = 7×10²² × 9.8 = 6.8×10²³ N (ROUND TO 10)

g = gravitational field strength = gravity constant = acceleration due to gravity

gravitational potential energy = mass × height × g.f.s

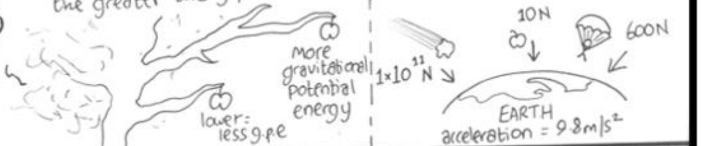
(J) = (kg) × (m) × (N/kg)

Basically, the greater the height, the greater the g.p.e. stored

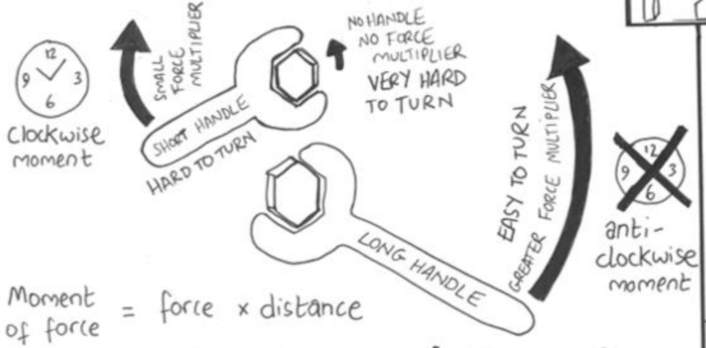
resultant force = mass × acceleration due to gravity

(N) = (kg) × (m/s²)

look – it's the same again!




## 4. Turning forces

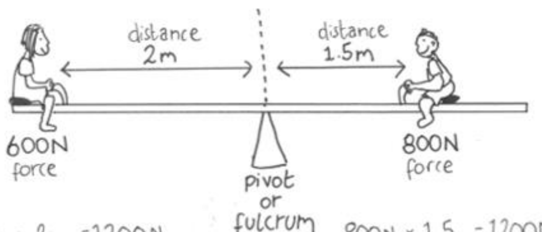



Moment of force = force × distance

(Nm) = (N) × (m)

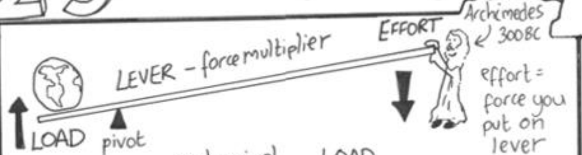
↑ clue is in the units!

### The Principle of Moments – Balanced




600N × 2m = 1200Nm   800N × 1.5m = 1200Nm

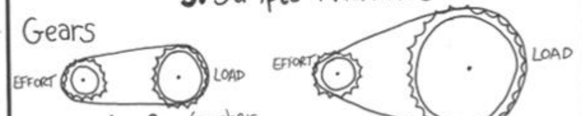
## 5. Simple machines




mechanical advantage = LOAD / EFFORT

load × distance from load to pivot = distance from pivot to effort × effort

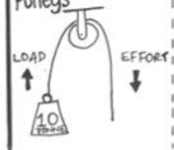
### Gears




Ratio 1 : 2 (number of teeth) — Smaller force multiplier, more effort to go fast

Ratio 1 : 4 — Bigger force multiplier, less effort to go fast

**Pulleys**




**Ramps** – inclined plane reduces effort to gain height

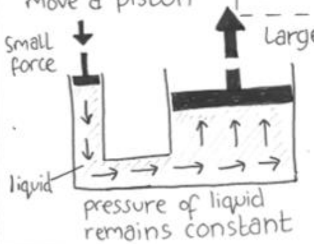
**Screwdrivers** – rotating levers — fatter handle turns easier

## 6. Hydraulics

water i.e. hydrate — using liquid to move a piston

## Pneumatics

air i.e. pneumonia (lung infection – lungs breathe oxygen from air) — using air (gas) to move a piston




surface area of piston

force = pressure × area

(N) = (Pa) × (m²)

∴ force multiplier

## Equations

- moment (Nm) = force (N) × distance (m)
- energy transferred (J) = 0.5 × spring constant (N/m) × (extension (m))²
- gravity force (N) = mass (kg) × gravitational field strength (N/kg)
- weight (N) = mass (kg) × gravitational field strength (N/kg)
- gravitational potential energy (J) = mass (kg) × height (m) × gravitational field strength (N/kg)
- force exerted by spring (N) = spring constant (N/m) × extension (m)